

WHAT IS CLAIMED IS

1. A structurally-modified water-soluble polymer having a reduced specific viscosity above 3 dl/g, the polymer prepared by initiating polymerization of an aqueous solution of monomers selected from the group consisting of acrylamide, methacrylamide, acrylic acid, sodium acrylate, ammonium acrylate, methacrylic acid, sodium methacrylate, ammonium methacrylate, 2-acrylamido-2-methylpropanesulfonic acid, 2-acrylamido-2-methylpropanesulfonic acid sodium salt, dialkylaminoalkyl acrylates and methacrylates and their quaternary or acid salts and dialkylaminoalkylacrylamides or methacrylamides and their quaternary or acid salts under free radical polymerization conditions to form a polymer solution and adding at least one structural modifier to the polymer solution after at least 30% polymerization of the monomers has occurred.
2. The structurally-modified water-soluble polymer according to claim 1 wherein the dialkylaminoalkyl acrylates and methacrylates and their quaternary or acid salts are selected from the group consisting of dimethylaminoethyl acrylate methyl chloride quaternary salt, dimethylaminoethyl acrylate methyl sulfate quaternary salt, dimethylaminoethyl acrylate benzyl chloride quaternary salt, dimethylaminoethyl acrylate sulfuric acid salt, dimethylaminoethyl acrylate hydrochloric acid salt, dimethylaminoethyl methacrylate methyl chloride quaternary salt, dimethylaminoethyl methacrylate methyl sulfate quaternary salt, dimethylaminoethyl methacrylate benzyl chloride quaternary salt, dimethylaminoethyl methacrylate sulfuric acid salt and dimethylaminoethyl methacrylate hydrochloric acid salt.
3. The structurally-modified water-soluble polymer according to claim 1 wherein the dialkylaminoalkylacrylamides or methacrylamides and their quaternary or acid salts are selected from the group consisting of acrylamidopropyltrimethylammonium chloride, dimethylaminopropyl acrylamide methyl sulfate quaternary salt, dimethylaminopropyl acrylamide sulfuric acid salt, dimethylaminopropyl acrylamide hydrochloric acid salt, methacrylamidopropyltrimethylammonium chloride, dimethylaminopropyl methacrylamide methyl sulfate quaternary salt, dimethylaminopropyl methacrylamide sulfuric acid salt and dimethylaminopropyl methacrylamide hydrochloric acid salt.

4. The structurally-modified water-soluble polymer according to claim 1 wherein the monomers are selected from the group consisting of acrylamide, methacrylamide, dimethylaminoethyl acrylate methyl chloride quaternary salt, dimethylaminoethyl acrylate benzyl chloride quaternary salt, 5 acrylamidopropyltrimethylammonium chloride, dimethylaminoethyl methacrylate methyl chloride quaternary salt, methacrylamidopropyltrimethylammonium chloride, acrylic acid, sodium acrylate, ammonium acrylate, methacrylic acid, sodium methacrylate and ammonium methacrylate.

10 5. The structurally-modified water-soluble polymer according to claim 1 selected from the group consisting of emulsion polymers, dispersion polymers and gel polymers.

15 6. The structurally-modified water-soluble polymer of claim 1 wherein the structural modifier is selected from the group consisting of cross-linking agents, chain transfer agents and mixtures thereof.

7. The structurally modified polymer of claim 6 selected from the group consisting of emulsion polymers.

20 8. The structurally-modified water-soluble polymer of claim 6 wherein the chain transfer agents are selected from the group consisting of alcohols, sulfur compounds, carboxylic acids or salts thereof, phosphites, and combinations thereof.

25 9. The structurally-modified water-soluble polymer of claim 8 wherein the chain transfer agents are selected from sodium formate and sodium hypophosphite.

10. The structurally-modified water-soluble polymer of claim 6 wherein the cross-linking agent is selected from the group consisting of *N,N*-methylenebisacrylamide, *N,N*-methylenebismethacrylamide, triallylamine, triallyl ammonium salts, ethylene glycol dimethacrylate, diethylene glycol dimethacrylate, polyethylene glycol diacrylate, polyethylene glycol dimethacrylate, *N*-vinylacrylamide, *N*-methylallylacrylamide, vinyltrimethoxysilane, and combinations thereof.

11. The structurally-modified water-soluble polymer of claim 10 wherein the cross-linking agent is vinyltrimethoxysilane.

12. The structurally-modified water-soluble polymer of claim 10 wherein the cross-linking agent is methylenebisacrylamide.

13. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and dimethylaminoethylacrylate benzyl chloride quaternary salt and the structural modifier is vinyltrimethoxysilane.

14. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is methylenebisacrylamide.

15. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is sodium formate.

16. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is sodium hypophosphite.

17. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is a combination of sodium formate and methylenebisacrylamide.
- 5 18. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide, dimethylaminoethylacrylate benzyl chloride quaternary salt and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is methylenebisacrylamide.
- 10 19. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide, dimethylaminoethylacrylate benzyl chloride quaternary salt and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is sodium formate.
- 15 20. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide, dimethylaminoethylacrylate benzyl chloride quaternary salt and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is a combination of methylenebisacrylamide and sodium formate.
- 20 21. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide, dimethylaminoethylacrylate benzyl chloride quaternary salt and dimethylaminoethylacrylate methyl chloride quaternary salt and the structural modifier is vinyltrimethoxysilane.
- 25 22. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and acrylic acid or a salt thereof and the structural modifier is sodium hypophosphite.
23. The structurally-modified water-soluble polymer of claim 4 wherein the monomers are acrylamide and acrylic acid or a salt thereof and the structural modifier is sodium formate.

24. A method of preparing a structurally-modified water-soluble polymer comprising initiating polymerization of an aqueous solution of monomers selected from the group consisting of acrylamide, methacrylamide, acrylic acid, sodium acrylate, ammonium acrylate, methacrylic acid, sodium methacrylate, ammonium methacrylate, 2-acrylamido-2-methylpropanesulfonic acid, 2-acrylamido-2-methylpropanesulfonic acid sodium salt, dialkylaminoalkyl acrylates and methacrylates and their quaternary or acid salts and dialkylaminoalkylacrylamides or methacrylamides and their quaternary or acid salts under free radical polymerization conditions to form a polymer solution and adding at least one structural modifier to the polymer solution after at least 30% polymerization of the monomers has occurred.
25. A method of flocculating an aqueous suspension of organic matter comprising adding to the suspension an effective flocculating amount of the structurally-modified polymer of claim 1.
26. A method of clarifying waste water comprising adding an effective flocculating amount of the structurally-modified water-soluble polymer of claim 1 to the waste water.
27. A method of increasing retention and drainage in a papermaking furnish comprising adding an effective amount of the structurally-modified water-soluble polymer of claim 1 to the furnish.
28. The method of claim 27 further comprising adding a microparticle to the furnish.
29. The method of claim 27 further comprising adding a coagulant to the furnish.
30. A method of flocculating an aqueous coal refuse slurry comprising adding an effective amount of the structurally-modified water-soluble polymer of claim 1 to the slurry